



US010608816B2

(12) **United States Patent**
Pizano et al.

(10) **Patent No.: US 10,608,816 B2**
(45) **Date of Patent: Mar. 31, 2020**

(54) **AUTHENTICATION SYSTEM FOR
ENHANCING NETWORK SECURITY**

(56) **References Cited**

U.S. PATENT DOCUMENTS

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5,648,648 A * 7/1997 Chou G07C 9/00158
235/375
5,666,400 A * 9/1997 McAllister G10L 15/25
379/189

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(Continued)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 1149 days.

FOREIGN PATENT DOCUMENTS

WO WO 9704375 A3 * 7/1997 G06F 21/32
WO WO 9858346 A1 * 12/1998 G06F 3/03547

(21) Appl. No.: **13/549,967**

OTHER PUBLICATIONS

(22) Filed: **Jul. 16, 2012**

IBM Unveils First Biometric ThinkPad, Offering Security at Your Fingertips. Oct. 4, 2004. IBM News Release.*

(65) **Prior Publication Data**
US 2012/0304270 A1 Nov. 29, 2012

(Continued)

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(57) **ABSTRACT**

A network-based biometric authentication system includes a client computer (10), a third party server (24), and a biometric authentication server (26). A user requests access to a web site hosted by the third party server via the client computer, wherein the third party server communicates a deployable object to the client computer. The client computer executes the deployable object, wherein the object enables the client computer to receive a user name, password, and biometric data from the user and to communicate the user name, password, and biometric data to the biometric authentication server in a secure fashion. The biometric authentication server authenticates the user name, password, and biometric data, and communicates the user name and password to the third party server, which attempts to verify the user name and password in a conventional manner and grants access to the user if the user name and password are verified.

Related U.S. Application Data

(63) Continuation of application No. 12/913,126, filed on Oct. 27, 2010, now Pat. No. 8,225,384, which is a (Continued)

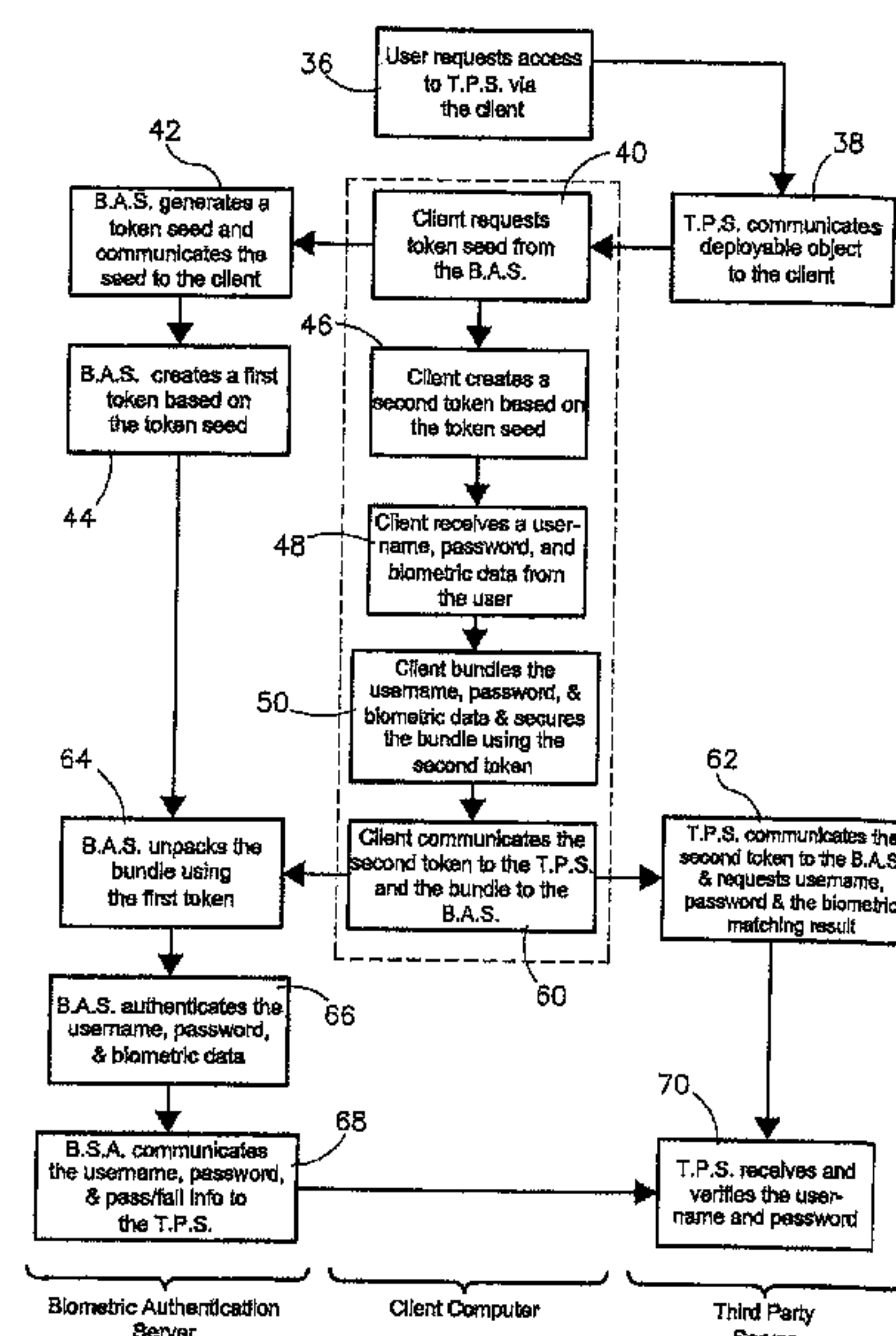
(51) **Int. Cl.**
H04L 9/32 (2006.01)
H04L 29/06 (2006.01)

(52) **U.S. Cl.**
CPC **H04L 9/3213** (2013.01); **H04L 9/3231** (2013.01); **H04L 63/0861** (2013.01); **H04L 63/0428** (2013.01)

(58) **Field of Classification Search**
CPC . H04L 9/3213; H04L 9/3231; H04L 63/0861; G06F 21/10; G06F 21/33

See application file for complete search history.

7 Claims, 4 Drawing Sheets



Related U.S. Application Data

continuation of application No. 11/279,715, filed on
Apr. 13, 2006, now abandoned.

(56) References Cited

U.S. PATENT DOCUMENTS

6,148,094 A * 11/2000 Kinsella G06F 3/03549
345/167
2001/0027527 A1 * 10/2001 Khidekel G06F 21/32
726/9
2002/0010679 A1 * 1/2002 Felsher G06F 19/322
705/51
2004/0083215 A1 * 4/2004 de Jong G06F 21/10
2007/0044143 A1 * 2/2007 Zhu G06F 21/33
726/8
2007/0245152 A1 * 10/2007 Pizano H04L 63/0861
713/186
2010/0223663 A1 * 9/2010 Morimoto G06F 21/32
726/7
2010/0287369 A1 * 11/2010 Monden G06F 21/32
713/156

OTHER PUBLICATIONS

Jack Germain. IBM Introducing Fingerprint Reader into Laptop.
Oct. 4, 2004. TechnewsWorld.*
Wei G., Li D. (2006) Biometrics: Applications, Challenges and the
Future. In: Strandburg K.J., Raicu D.S. (eds) Privacy and Tech-
nologies of Identity. Springer, Boston, MA.*

* cited by examiner

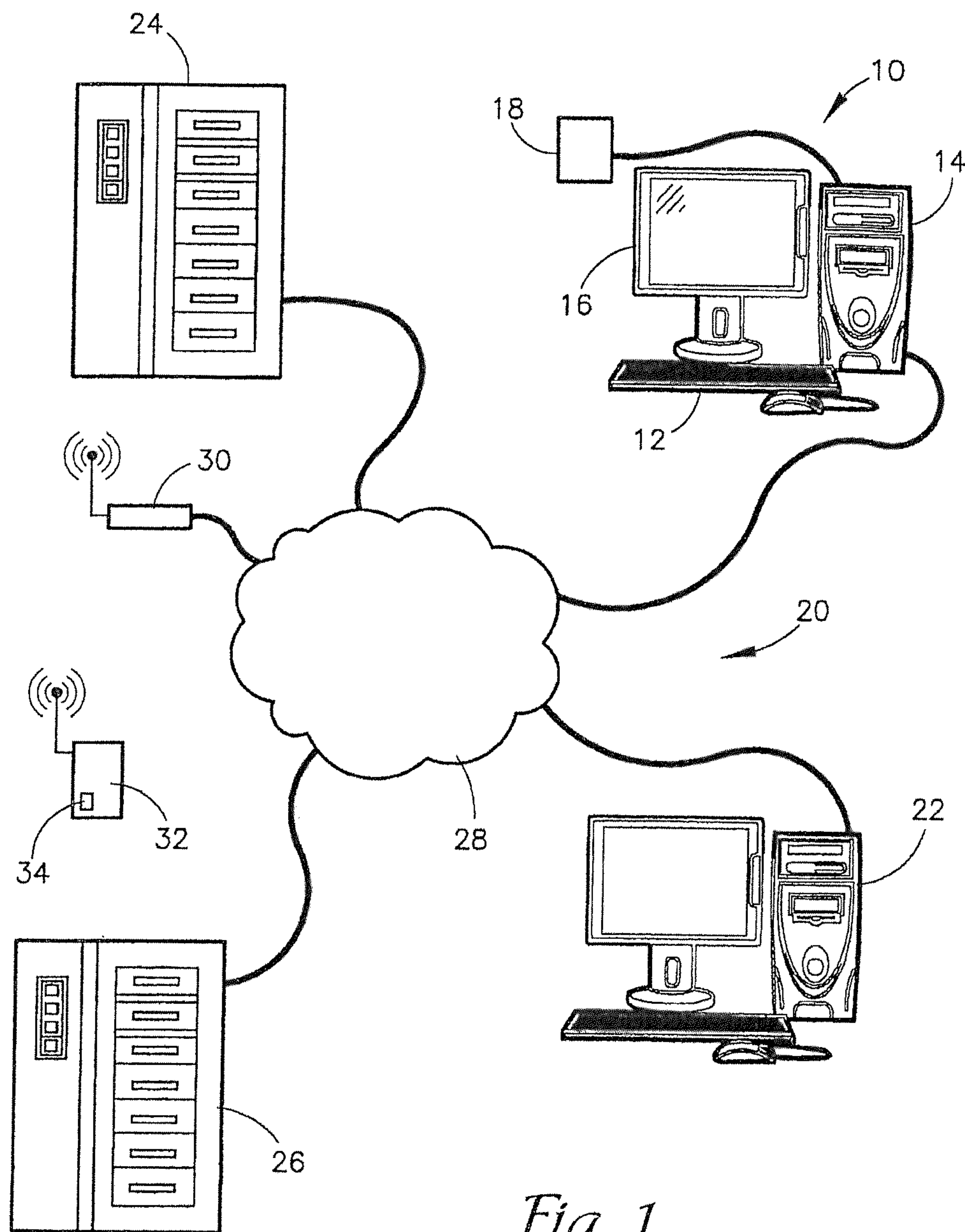
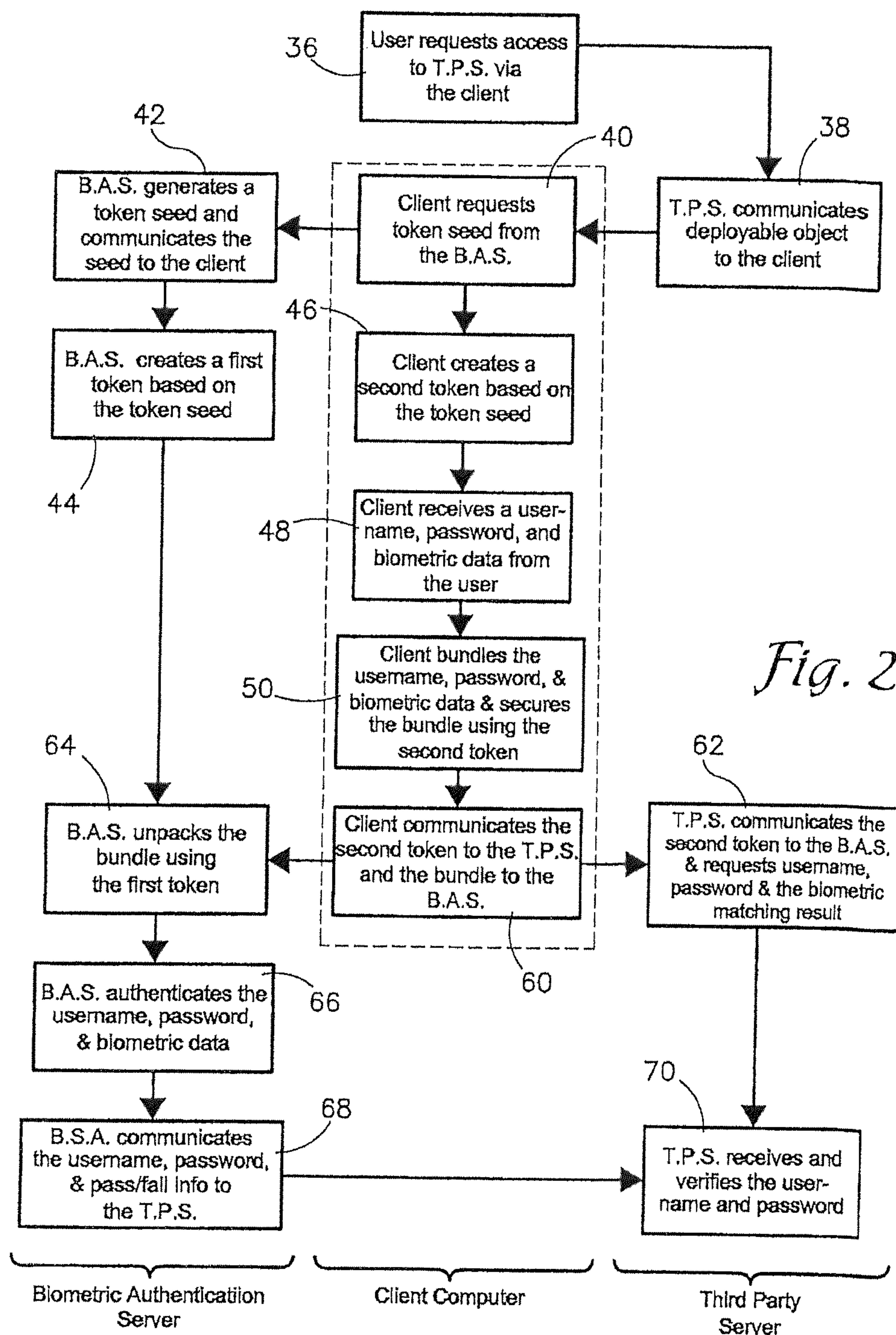
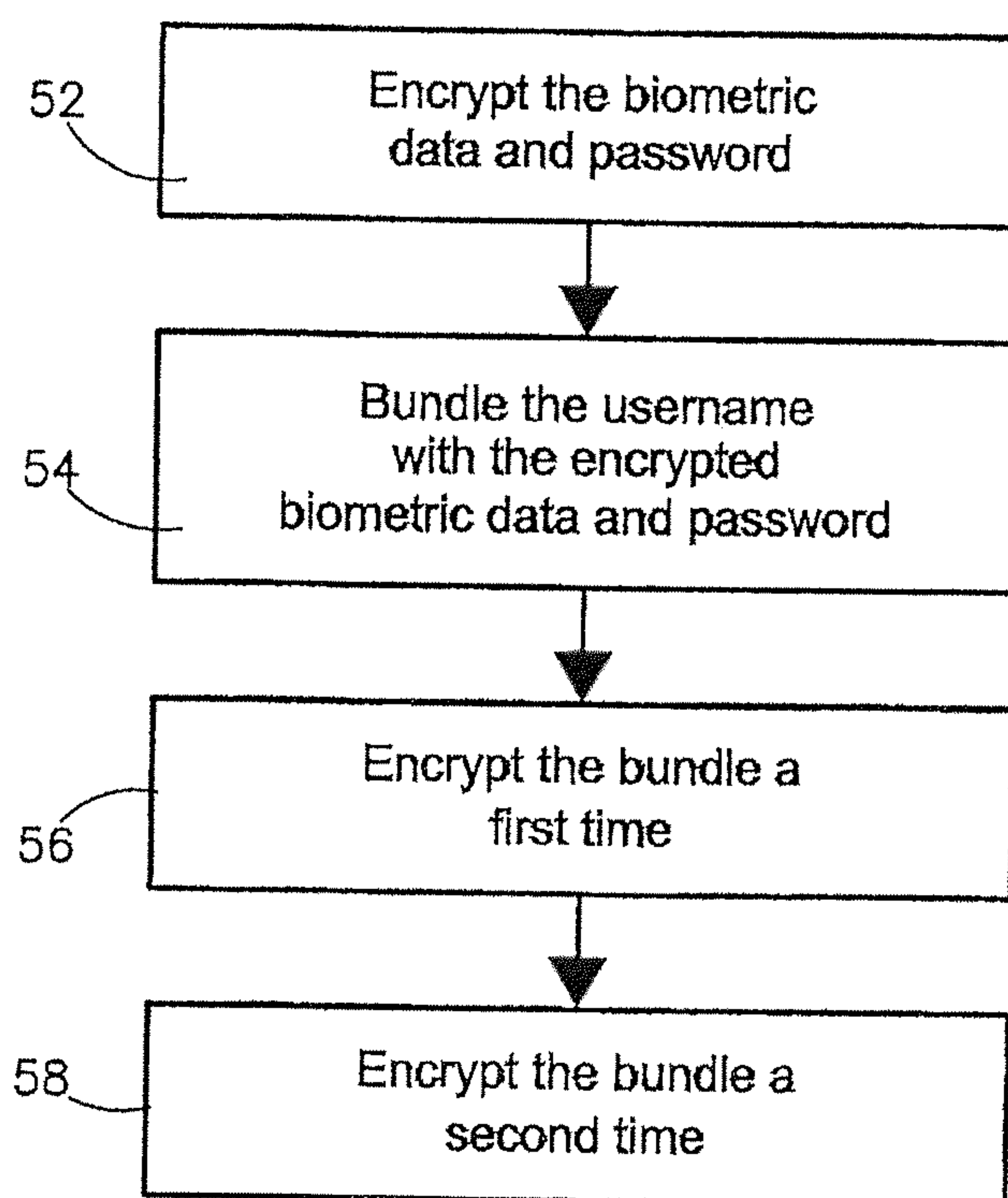


Fig. 1



*Fig. 3*

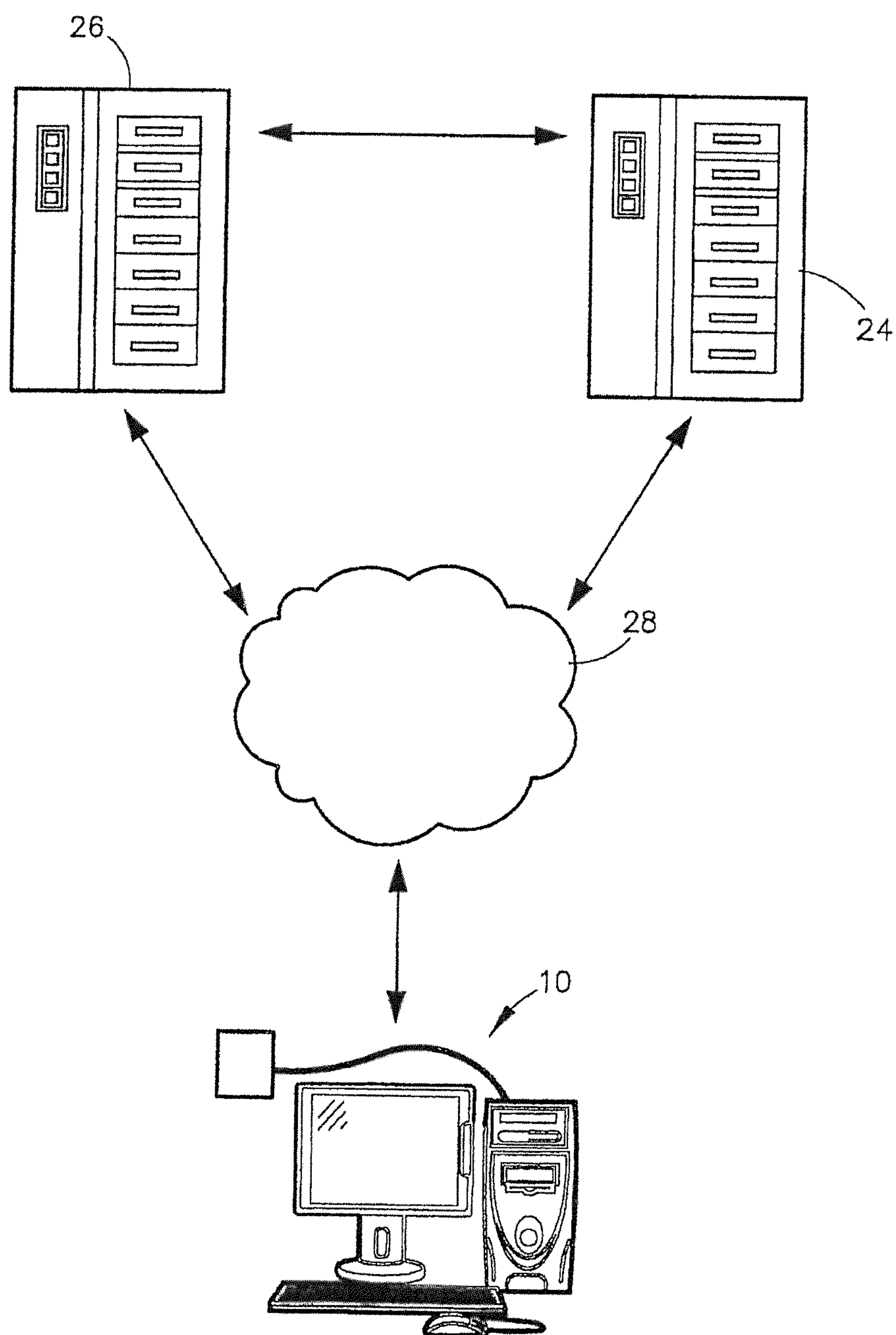


Fig. 4

AUTHENTICATION SYSTEM FOR ENHANCING NETWORK SECURITY

RELATED APPLICATIONS

This application is a continuation, and claims priority benefit with regard to all common subject matter, of U.S. patent application Ser. No. 12/913,126, filed Oct. 27, 2010, entitled "AUTHENTICATION SYSTEM FOR ENHANCING NETWORK SECURITY," which is now U.S. Pat. No. 8,225,384, issued Jul. 17, 2012 ("the '384 Patent"). The '384 Patent is a continuation of U.S. patent application Ser. No. 11/279,715, filed Apr. 13, 2006, entitled "BIOMETRIC AUTHENTICATION SYSTEM FOR ENHANCING NETWORK SECURITY," which is now abandoned. The earlier-filed patent and patent application are hereby incorporated by reference in their entirety into the present application.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to the field of computer security. More particularly, the present invention involves a system for transparently enhancing secure access to a network node by validating a user's identity using biometric data, wherein biometric authentication occurs on a biometric authentication server and the network node to which access is sought initiates the biometric authentication process.

2. Description of Prior Art

Providing secure Internet transactions has become increasingly important as use of the Internet for business, financial, and other sensitive transactions has become ubiquitous. Traditionally, network servers hosted by businesses have been programmed to require a user to submit identification information, such as a user name and a password, before allowing the user to access files managed by the server.

Use of such identification information renders the server susceptible to access by unauthorized users who obtain a valid user's identification information by, for example, intercepting network communications. Requiring a user's biometric data, such as a fingerprint, before granting the user access is known in the art and benefits from the added measure of security inherent in biometric authentication systems. For example, fingerprint data and other biometric data cannot be "stolen" as easily as a user name and password, and, even if stolen, cannot be used to circumvent security if the system requires the user to submit fresh biometric data via a biometric sensor.

While use of biometric data increases the security of computer networks, it also requires special hardware and software to implement. For example, fingerprint-based biometric authentication requires use of a fingerprint scanner, driver software for the scanner, and software for authenticating fingerprint data received via the fingerprint scanner. Authenticating the fingerprint data may include, for example, comparing the data with fingerprint data stored in a database to determine whether the received data matches the stored data. Thus, implementing a biometric authentication system can require significant hardware and software resources that, in some circumstances, render it impractical or even impossible to implement.

Accordingly, there is a need for an improved network security system that does not suffer from the problems and limitations of the prior art.

SUMMARY OF THE INVENTION

The present invention provides an improved biometric authentication system for network transactions. Particularly,

the present invention provides a system for transparently enhancing secure access to a network node by validating a user's identity using biometric data, wherein biometric authentication occurs on a biometric authentication server and the network node to which access is sought initiates the biometric authentication process.

A first embodiment of the invention is a computer program for enabling a biometric authentication system, wherein at least a portion of the program is stored on a computer-usable medium. The computer program enables a first computer to receive biometric data and identification information from a user and to communicate the biometric data and the identification information to a second computer. The second computer creates a first transaction identifier, and verifies the identification information by confirming that the biometric data corresponds to at least a portion of the identification information.

The program further enables a third computer to communicate to the second computer a request for at least a portion of the identification information, wherein the request includes a second transaction identifier. The second computer communicates at least a portion of the identification information to the third computer if the first transaction identifier corresponds to the second transaction identifier and if the biometric data corresponds to at least a portion of the identification information.

According to a second embodiment of the invention, the program enables a first computer to communicate a deployable object to a second computer via a network communications medium, wherein the deployable object enables the second computer to generate a first token, to receive identification information and biometric data from a user, to bundle the biometric data with the token and secure the bundle, and to communicate the first token to the first computer and the bundle to a third computer.

The program enables the third computer to create a second token and to verify the first token received from the second computer by determining whether the first token corresponds to the second token, and enables the third computer to verify the biometric data received from the second computer by comparing the received data to biometric data stored in a database.

The third computer communicates the identification information received from the second computer to the first computer if the second token corresponds to the first token, if the received biometric data matches biometric data stored in the database, and if the biometric data corresponds to at least a portion of the identification information.

According to a third embodiment of the invention, the program enables a network server computer to communicate an ActiveX control to a network client computer via a network communications medium, wherein the ActiveX control enables the client computer to generate a first token, to receive a user name and password from the user, to control a biometric sensor and receive biometric data from the user via the sensor, to combine and encrypt the biometric data and password, to combine the user name with the encrypted biometric data and password to form a bundle and encrypt the bundle, and to communicate the first token to the network server computer and the bundle to the biometric authentication server.

The biometric authentication server creates a second token and determines whether the first token corresponds to the second token, determines whether the biometric data received from the client matches biometric data stored in a

database, and determines whether the biometric data received from the client corresponds to the user name or the password.

The biometric authentication server communicates the user name and password received from the client computer to the network server computer if the first token corresponds to the second token, if the biometric data received from the client matches biometric data stored in a database, and if the biometric data received from the client corresponds to the user name or the password.

These and other important aspects of the present invention are described more fully in the detailed description below.

BRIEF DESCRIPTION OF THE DRAWINGS

An embodiment of the present invention is described in detail below with reference to the attached drawing figures, wherein:

FIG. 1 is a schematic diagram of an exemplary system for implementing a computer program in accordance with an embodiment of the present invention;

FIG. 2 is a flow diagram of certain steps performed by the computer program for providing transparent biometric authentication for network-based transactions;

FIG. 3 is a flow diagram of certain steps performed by the computer program for bundling and securing identification and biometric information for communication in a network-based transaction; and

FIG. 4 is a schematic diagram of an exemplary communication scheme of the system of FIG. 1 involving a biometric authentication server, a third party server, and a client computer, wherein the biometric authentication server and the third party server are on a first side of a firewall and communicate via the Internet with the client which is on a second side of the firewall.

DETAILED DESCRIPTION

The present invention relates to a system and method of enhancing network security by providing transparent biometric authentication for network transactions. The method of the present invention is especially well-suited for implementation on a computer or computer network, such as the computer 10 illustrated in FIG. 1 that includes a keyboard 12, a processor console 14, a display 16, and one or more peripheral devices 18, such as a scanner or printer. The computer 10 may be a part of a computer network, such as the computer network 20 that includes one or more client computers 10, 22 and one or more server computers 24, 26 interconnected via a communications system 28. The communications system 28 may include, for example, a local area network, wide area network, the Internet, or a combination thereof. As illustrated in FIG. 4, the servers 24 and 26 may be connected to a local area network or other local communication means residing on a first side of a firewall and communicate with the client computer 10 residing on a second side of the firewall via the Internet 28.

The present invention may also be implemented, in whole or in part, on a wireless communications system including, for example, a network-based wireless transmitter 30 and one or more wireless receiving devices, such as a hand-held computing device 32 with wireless communication capabilities, wherein the device 32 is a client of the network 20 and includes a peripheral element 34. The present invention will thus be generally described herein as a computer program. It will be appreciated, however, that the principles of the present invention are useful independently of a

particular implementation or embodiment, and that one or more of the steps described herein may be implemented without the assistance of a computing device.

The present invention can be implemented in hardware, software, firmware, or a combination thereof. In a preferred embodiment, however, the invention is implemented with a computer program. The computer program and equipment described herein are merely examples of a program and equipment that may be used to implement the present invention and may be replaced with other software and computer equipment without departing from the scope of the present invention.

The computer program of the present invention is stored in or on a computer-usable medium, such as a computer-readable medium, residing on or accessible by a host computer or a plurality of host computers for instructing the host computer or computers to implement the method of the present invention as described herein. The host computer may be a server computer, such as server computer 24, or a network client computer, such as computer 10 or device 32. The computer program preferably comprises an ordered listing of executable instructions for implementing logical functions in the host computer and other computing devices coupled with the host computer. The computer program can be embodied in any computer-usable medium for use by or in connection with an instruction execution system, apparatus, or device, such as a computer-based system, processor-containing system, or other system that can fetch the instructions from the instruction execution system, apparatus, or device, and execute the instructions.

The ordered listing of executable instructions comprising the computer program of the present invention will hereinafter be referred to simply as “the program” or “the computer program.” It will be understood by those skilled in the art that the program may comprise a single list of executable instructions or two or more separate lists, and may be stored on a single computer-readable medium or multiple distinct media, including multiple geographically separate media. The program will also be described as comprising various “code segments,” which may include one or more lists, or portions of lists, of executable instructions. Code segments may include overlapping lists of executable instructions, that is, a first code segment may include instruction lists A and B, and a second code segment may include instruction lists B and C.

In the context of this document, a “computer-usable medium” can be any means that can contain, store, communicate, propagate or transport the program for use by or in connection with the instruction execution system, apparatus, or device. The computer-usable medium can be, for example, but is not limited to, an electronic, magnetic, optical, electro-magnetic, infrared, or semi-conductor system, apparatus, device, or propagation medium. More specific, although not inclusive, examples of the computer-usable medium would include the following: an electrical connection having one or more wires, a portable computer diskette, a random access memory (RAM), a read-only memory (ROM), an erasable, programmable, read-only memory (EPROM or Flash memory), an optical fiber, and a portable compact disk read-only memory (CDROM). The computer-usable medium could even be paper or another suitable medium upon which the program is printed, as the program can be electronically captured, via for instance, optical scanning of the paper or other medium, then compiled, interpreted, or otherwise processed in a suitable manner, if necessary, and then stored in a computer memory. In the context of this document, an “object” is a self-

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contained software entity that consists of both data and procedures to manipulate the data.

In a first embodiment, the present invention enables enhanced, transparent network security between a network client computer **10** and a third party network server **24** by employing a biometric identification server **26**. The client computer **10** may be substantially any convention personal computer or computer workstation with access to the network **20**, such as, for example, where the network **20** is the Internet. Thus, the client computer **10** may be in a user's home, office, vehicle or another location. The client computer **10** includes a biometric sensor **18** operable to capture the user's biometric data, such as fingerprint data. In the first embodiment the biometric sensor **18** is a fingerprint scanner for capturing fingerprint data, but it will be appreciated that substantially any biometric data may be used without departing from the scope of the claimed invention including, but not limited to, voice print data, retinal scan data, iris scan data, facial characteristics, and behavioral characteristics, such as signature data, captured and analyzed using conventional hardware and processes known in the art. Furthermore, the biometric data used by the claimed invention may be any combination of one or more types of such biometric data.

The third party network server **24** is a device or system that manages network resources, such as network traffic or network storage devices dedicated to storing data files, and may be a conventional network server computer or server station. More specifically, the third party network server **24** may be a World Wide Web server hosting a web page or a web site, wherein the server **24** requires user identification before granting access to the web page or web site. The third party network server **24** may be implemented independently of the client computer **10** and by a third party not associated with the client computer **10**.

The biometric authentication server **26** may be similar to the third party network server **24**, but is operable to perform a particular function. The biometric authentication server **26** is operable to store and manage user identification information and user biometric information, such where the identification information and the biometric information are stored in a database that is accessible by, or resides on, the server **26**. As explained above, the communications system **28** provides a medium through which the client computer **10**, the third party server **24**, and the biometric authentication server **26** communicate via any of various network communications protocols.

Referring also to FIG. 2, a flow diagram of exemplary steps involved in the first embodiment of the present invention is illustrated. The steps illustrated in FIG. 2 need not be executed in precisely the order shown, but a second step illustrated subsequent to a first step may be executed concurrently with, or in some cases prior to, the first step. The steps are divided into three columns, wherein a left column generally includes steps performed by the biometric authentication server **26**, the middle column generally includes steps performed by the client computer **10**, and the right column generally includes steps performed by the third party server **24**.

First, a user requests access to the third-party server **24** via the client computer **10**, as depicted in block **36**. This step may occur, for example, when the user desires to engage in online banking and requests or selects a login page from the bank's web site via a web browser running on the client computer **10**, wherein the third party server **24** requires a valid user name and password to grant access to the web site. It will be appreciated that this scenario is only exemplary in

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nature and that the third-party server **24** need not be associated with a bank, but may be associated with any business, organization, group, association, or other entity. Furthermore, the user name and password discussed herein are exemplary types of user identification information required by the third party server **24** before granting access to the user. Alternatively, the third party server **24** may require only the user name, only the password, or an entirely different form of identification, such as a digital certificate in the form of a data file stored on the client computer **10**.

Unless otherwise noted, communications between the client computer **10**, the third party server **24**, and the biometric authentication server **26** are encrypted or otherwise secured to prevent unintended recipients from opening, reading, or otherwise using communicated data and information.

When the user requests the login page from the third-party server **24** via the client computer **10**, the third party server **24** communicates a deployable object to the client computer **10**, as depicted in block **38**. The deployable object is a software object that is generated by, resides on, or is retrieved by the third-party server **24**, and is executed by the client computer **10** upon receipt thereof from the third party server **24** without the need for the client computer user to perform any installation or initiation steps. In other words, the client computer **10** receives and executes the deployable object transparently to the user. The object is "deployable" in that it can be communicated from a first computer to a second computer for execution on the second computer, wherein the object has access to the system resources of the second computer necessary to allow the object to perform all functions contained therein.

The client computer **10** executes the deployable object, which enables the client computer **10** to request a token seed from the biometric authentication server **26**, as illustrated in block **40**. The token seed serves as a basis to generate multiple identical tokens that are used as encryption and decryption keys as well as to associate a plurality of events or items with a single transaction. Thus, the tokens serve as transaction identifiers to enable the biometric authentication server **26** to associate a communication from the third party server **24** with a communication from the client computer **10**. This is particularly important where the biometric authentication server **26** is communicating with multiple external computers regarding multiple transactions. The biometric authentication server generates a token seed and communicates the token seed to the client computer **10**, as depicted in block **42**, and creates a first token from the token seed, as depicted in block **44**. The first token is retained by the biometric authentication server **26** to decrypt communications received from the client computer **10** and to associate communications from the third party server **24** and the biometric authentication server **26** with a single transaction.

A preferred deployable object is an ActiveX object, such as an ActiveX control, wherein the ActiveX control is communicated from the third party server **24** to the client computer **10** via a web browser running on the client computer **10**, wherein the ActiveX control can access system resources of the network client computer **10** but is extinguished from the client computer **10** when the web browser is terminated or is no longer in communication with the third party server **24**.

When the client computer **10** executes the deployable object, the object enables the client **10** to create a second token based on the token seed, as depicted in block **46**. The second token is identical to the first token or is otherwise associated with the first token such that when the biometric

authentication server **26** receives the second token it can associate the first token with the second token.

The deployable object enables the client computer **10** to receive a username, password, and biometric data from the user, as depicted in block **48**. In this step, the client computer **10** presents a user login page that prompts the user to submit a username and password in respective username and password fields. The user login page would also prompt the user to submit biometric data, such as fingerprint data via a fingerprint scanner. To enable the client computer **10** to receive biometric data from the user, the deployable object controls the biometric sensor **18** and provides a bridge between the biometric sensor **18** and the user interface of the client computer **10**. The deployable object may interact, for example, with a dynamically linked library associated with the biometric sensor **18** wherein the library provides executable functions and data necessary for the deployable object to communicate with and control the biometric sensor **18**.

Enabling the deployable object to communicate with and control the biometric sensor **18** reduces the risk of a person circumventing the biometric scanner **18** because the deployable object can ensure that biometric data is received from the biometric sensor **18** at the time the user submits the user name and password.

The deployable object enables the client computer **10** to bundle the user name, password, and biometric data together and secure the bundle, as depicted in block **50**. A flowchart of steps illustrating an exemplary method of bundling the user name, password, and biometric data is illustrated in FIG. **3**. First, the client computer **10** encrypts the biometric data and the password using the second token, as depicted in block **52**. The client computer **10** may combine the biometric data and the password prior to encryption, wherein such combination may include, for example, merging the fingerprint data and the password into a single file, or creating a file for each of the fingerprint data and the password and placing the two files into a single folder. The client computer **10** then bundles the username with the encrypted biometric data and password, as depicted in block **54**. The client computer **10** encrypts the bundle using the second token as an encryption key, as depicted in block **58**, and encrypts the bundle a second time using the second token as an encryption key, as depicted in block **60**.

Thus, the exemplary method of bundling and securing the user name, password, and biometric data comprises a multi-tiered encryption scheme involving three levels of encryption. It should also be noted that more sensitive data may be encrypted in a deeper layer than less sensitive data. The biometric data and the password may be considered more sensitive than the user name, for example, because the biometric data is unique to the user and cannot change, and the password may reflect passwords employed by the user in other systems or situations.

Referring again to FIG. **2**, once the client computer **10** has bundled the user name, password, and biometric data, the deployable object enables the client computer **10** to communicate the bundle to the biometric authentication server **26** and to communicate the second token to the third party server **24**, as depicted in block **60**. Blocks **40**, **46**, **48**, **50**, and **60**, illustrated inside a broken-line box, represent steps performed by the client computer **10** enabled by the deployable object.

The third party server **24** communicates a copy of the second token to the biometric authentication server **26** and requests a user name and password corresponding to the second token, as depicted in block **62**. Thus, the third party server **24** does not receive the user name and password

directly from the client computer **10**, but rather from the biometric authentication server **26**, as explained below.

The biometric authentication server **26** unpacks the bundle received from the client **10** using the first token, as depicted in block **64**. Unpacking the bundle is accomplished essentially by reversing the steps illustrated in FIG. **3**. For example, the bundle is decrypted a first time and a second time to reveal the user name, and the encrypted biometric data and password. The user name is separated from the encrypted biometric data and password, and the encrypted biometric data and password are decrypted and separated. In contrast to the bundling process illustrated in FIG. **3**, when the biometric authentication server **26** unpacks the bundle, it performs the decryption using the first token as a decryption key. Therefore, if the first token does not correspond to the second token, the decryption will fail.

The biometric authentication server **26** verifies the second token received from the third party server **24** by comparing it with the first token, which was created and retained by the biometric authentication server **26**. Because both the first token and the second token were created from the same token seed, both tokens will be identical or otherwise have a known relationship that can be used to verify that both were created from the same token seed and thus pertain to the same transaction.

The biometric authentication server **26** authenticates the user name, password, and biometric data, as depicted in block **66**. The received biometric data is authenticated by comparing it with biometric data stored in a database, wherein the received biometric data is authenticated if it matches biometric data stored in the database. The user name and password are authenticated if they match a user name and password that are stored in the database and associated with the biometric data stored in the database that matches the received biometric data. Alternatively, only a portion of the user identification information may be authenticated, such as only the user name, only the password, or a portion of either or both. If the user name, password, and biometric data are thus authenticated, the biometric authentication server **26** communicates the user name and the password to the third party server, as depicted in block **70**. The third party server **24** receives and verifies the user name and password in a conventional manner, as depicted in block **72**. This may involve, for example, comparing the user name and password to user names and passwords stored in a database and presenting the client computer **10** user with a home or welcome page. Alternatively, the biometric authentication server **26** may communicate only a portion of the identification information, such as only the user name or only the password, to the third party server **24**.

In a second embodiment of the invention, the wireless device **32** communicates with the third party server **24** and the biometric authentication server **26** in addition to, or in place of, the client computer **10**. This embodiment would otherwise be substantially similar to any of the other embodiments described herein, except that the device **32** would perform substantially all of the functions described above in relation to the client computer **10**. The user would submit biometric data via the biometric sensor **34**, for example, and would submit identification information via a conventional user interface (not shown) of the device **32** including, for example, a keypad, LCD, or similar user interface element or elements. In the second embodiment, the deployable object may need to be adapted for use with the wireless device **32**, particularly if the device **32** is a handheld device or otherwise has limited resources.

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A third embodiment of the invention is substantially similar to either the first or second embodiments, except that the software contained in the deployable object is installed in and resides upon the client computer **10**, the client device **32**, or both, instead of being communicated thereto upon the initiation of a transaction. In this embodiment, the program code executed by the client computer **10** may be installed on the client **10** prior to the user requesting access to the third party server **24** and may reside on the client **10** after each transaction. The third party server **24** would communicate only the token seed to the client computer **10**, rather than the deployable object and the token seed.

In a fourth embodiment of the invention, the deployable object is stored on or is generated by the biometric authentication server **26**, and is communicated from the biometric authentication server **26** directly to the client computer **10** or, alternatively, to the third party server **24**, which in turn communicates the object to the client computer **10**.

Although the invention has been described with reference to the preferred embodiments illustrated in the attached drawings, it is noted that equivalents may be employed and substitutions made herein without departing from the scope of the invention as recited in the claims. It will be appreciated, for example, that the client computer **10**, the third party server **24**, and the biometric authentication server **26** may be interconnected via any of various communication means including, for example, peer-to-peer communication protocols.

Having thus described a preferred embodiment of the invention, what is claimed as new and desired to be protected by Letters Patent includes the following:

The invention claimed is:

1. A non-transitory computer-readable storage medium with an executable program stored thereon for enabling authentication of a user at a third-party server, wherein at least one item of stored biometric identification information received from the user is stored so as to be accessible by at least an authentication server, wherein the computer program instructs one or more processors to perform steps of:
 - receive, by a biometric sensor of a client computer and from the user, user biometric identification information;
 - encrypt, by the client computer, the user biometric identification information to obtain encrypted user biometric identification information;
 - transmit, by the client computer and to the authentication server, the encrypted user biometric identification information;
 - transmit, by the client computer and to the third-party server, at least one item of user authentication information;

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decrypt, by the authentication server, the encrypted user biometric identification information;

authenticate, by the authentication server, the user based on the stored biometric identification information to obtain an authenticated user;

receive, by the authentication server and from the third-party server, the at least one item of user authentication information; and

based on the received at least one item of user authentication information and the authenticated user, grant access to the user to the third-party server wherein the authentication server generates keying information,

wherein the authentication server transmits the keying information to the client computer for deriving a key,

wherein the user biometric identification information is encrypted using the key derived from the keying information transmitted by the authentication server.

2. The computer-readable storage medium of claim 1, wherein the client computer is a handheld device.

3. The computer-readable storage medium of claim 1, wherein the key used to encrypt the user biometric identification information is a first key, and

wherein the user authentication information transmitted by the client computer to the third-party server is encrypted by or is a second key.

4. The computer-readable storage medium of claim 3, wherein the second key is derived from information provided by the authentication server, and such information is the same as the information used to derive the first key.

5. The computer-readable storage medium of claim 1, wherein the step of granting access to the user to the third-party server based on the received user authentication information and the authenticated user includes the step of confirming the user authentication information received by the authentication server and from the third-party server is derived from or includes the information provided by the authentication server and to the client computer.

6. The computer-readable storage medium of claim 1, wherein the step of authenticating the user based on the stored biometric identification information includes confirming the stored biometric identification information matches the decrypted user biometric identification information.

7. The computer-readable storage medium of claim 1, wherein the step of granting access to the user to the third-party server comprises granting access to the user to a particular resource associated with the third-party server.

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